



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 10/643,588 | 08/18/2003 | Kitrick Sheets | 1376.720US1 | 4010 |

21186 7590 04/19/2007
SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

| |
|-----------------|
| EXAMINER |
| TSAI, SHENG JEN |

| ART UNIT | PAPER NUMBER |
|----------|--------------|
| 2186 | |

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE | DELIVERY MODE |
|--|------------|---------------|
| 3 MONTHS | 04/19/2007 | PAPER |

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/643,588

Applicant(s)

SHEETS, KITRICK

Examiner

Sheng-Jen Tsai

Art Unit

2186

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 February 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4-6,9-11 and 14-18 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4-6,9-11 and 14-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 August 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. This Office Action is taken in response to Applicant's Amendments and Remarks filed on February 21, 2007 regarding application 10,643,588 filed on August 18, 2003.

2. Claims 4, 9 and 14 have been amended.

Claims 16-18 have been added.

Claims 2-3, 7-8 and 12-13 have been cancelled previously.

Claims 1, 4-6, 9-11 and 14-18 are pending under consideration.

3. **Response to Remarks and Amendments**

Applicant's amendments and remarks have been fully and carefully considered, with the Examiner's response set forth below.

Rejections of claims 4-5 under 35 U.S.C. 112, second paragraph have been withdrawn in light of the amendments on claim 4.

Applicant contend that Vishin et al. (US 5,860,146) does not teach the limitation of "if the translation is received then loading the translation into a translation lookaside buffer (TLB) on the source node," as recited in claim 1. The Examiner disagrees.

It is noted that this limitation is only conditional because it recites "if the translation is received then loading the translation ..." In other words, loading the translation into a translation lookaside buffer (TLB) on the source node needs not to occur if the translation is not received. Thus, just for the sake of argument, assuming that Vishin's scheme is different from Applicant's invention in that no translation is received and no translation is loaded into the TLB at the sourer node, it would still read on the claim limitation because the claim only requires loading the translation into a

Art Unit: 2186

translation lookaside buffer (TLB) on the source node under the condition that if the translation is received.

Thus, for the above reason alone, Vishin's teaching still reads on the recited limitation.

Applicant also contend that Vishin does not mention the element of "a virtual node." The Examiner disagrees.

First, figure 1 of Vishin shows a system comprising a plurality of clusters. Each of the clusters represents a node.

Second, figure 7 of Vishin shows a format of Remote Physical Page Address (RPPA) entry, including the node-ID (170).

Third, Vishin's invention is directed toward to auxiliary translation lookaside buffer for assisting in accessing data in remote address space [abstract]. The remote address space includes those memory located at the remote nodes, and as far as users at the local node is concerned, those memory locations at the remote nodes are considered as "virtual addresses," and those remote nodes are considered as "virtual nodes" [abstract].

Applicant further contends that Vishin does not mention the limitation of "locating the ERTT header at a well known location to one or more nodes used by an application." The Examiner disagrees.

Figure 1, 160 of Vishin shows that a RTLb is in place for every node in the system, and Vishin's invention is anchored by using the RTLb to access data in remote address spaces [abstract].

Therefore, the Examiner's position regarding the merit of patentability of all claims remains the same as stated in the previous Office Action.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1, 4-6, 9-11 and 14-18 are rejected under 35 U.S.C. 102(b) as being anticipated by Vichin et al. (US 5,860,146).

As to claim 1, Vichin et al. disclose **a method for translating a virtual memory address into a physical memory address** [Auxiliary Translation Lookaside Buffer for Assisting in Accessing Data in Remote Address Spaces (title); figure 5; The present invention relates generally to multiprocessor computer systems having virtual memory management subsystems, and particularly to a memory controller that manages access to remote physical addresses through the use of an auxiliary translation lookaside buffer (column 1, lines 5-10)] **in a multi-node system** [figure 1 shows a multi-node system where each cluster (102) represents a node connected together by a network (114)], **the method comprising:**

Initializing [in order for the remote translation mechanism disclosed by Vishin et al. to work and function properly, it is inherent that the RTT at all the nodes be initialized and synchronized first before any reference to a memory location resides at a remote node can be served. Without the initialization and synchronization, the RTT may not have

Art Unit: 2186

the correct information to reach the correct memory location] **in a generally accessible memory** [figures 2 and 4 show that the RPTE comprising a DRAM (108)] **an emulated remote translation table (ERTT) segment** [figure 4 shows the Remote Page Table Entries (RPTE); figure 6];

providing the virtual memory address at a source node [The primary translation lookaside buffer translates a virtual address asserted by the data processor into a physical address. When the physical address does not correspond to a location in local memory, the RTLB determines whether the physical address matches at least one of the remote page table entries stored in the RTLB, and selects one of those remote page table entries when at least one match is found. Then, a remote physical address is generated by combining a portion of the selected remote page table entry with a portion of the physical address (column 3, lines 40-60)];

determining a virtual node to query based on the virtual memory address [refer to "Response to Remarks and Amendments" presented earlier in this Office Action; figure 7, 170 shows the Node-ID field that provides the virtual node information];

accessing an ERTT header to obtain a mapping of the virtual node to a physical node [figure 7, 168 shows an ERTT header (the RPPA entry) comprising Node-ID, size, control flag and remote physical page address; figure 6 further shows that a plurality of the RPPA entries being organized and being accesses using the index V; figure 5 illustrates how the mapping from a virtual node to a physical node is accomplished; The primary translation lookaside buffer translates a virtual address asserted by the data processor into a physical address. When the physical address

Art Unit: 2186

does not correspond to a location in local memory, the RTLB determines whether the physical address matches at least one of the remote page table entries stored in the RTLB, and selects one of those remote page table entries when at least one match is found. Then; a remote physical address is generated by combining a portion of the selected remote page table entry with a portion of the physical address (column 3, lines 40-60)];

querying the ERTT segment on the physical node for the translation for the virtual memory address [figures 5-8 illustrates how this mapping is accomplished;

The primary translation lookaside buffer translates a virtual address asserted by the data processor into a physical address. When the physical address does not

correspond to a location in local memory, the RTLB determines whether the physical address matches at least one of the remote page table entries stored in the RTLB, and selects one of those remote page table entries when at least one match is found. Then, a remote physical address is generated by combining a portion of the selected remote page table entry with a portion of the physical address (column 3, lines 40-60)]; **and**

if the translation is received then loading the translation into a translation

lookaside buffer (TLB) on the source node [refer to "Response to Remarks and

Amendments" presented earlier in this Office Action; figures 5-8 illustrates how this

mapping is accomplished; The primary translation lookaside buffer translates a virtual address asserted by the data processor into a physical address. When the physical

address does not correspond to a location in local memory, the RTLB determines

whether the physical address matches at least one of the remote page table entries

stored in the RTLB, and selects one of those remote page table entries when at least one match is found. Then, a remote physical address is generated by combining a portion of the selected remote page table entry with a portion of the physical address (column 3, lines 40-60)].

As to claim 4, Vishin et al. teaches **the method of claim 1, further comprising locating the ERTT header located at a well-known location to one or more nodes used by an application** [refer to "Response to Remarks and Amendments" presented earlier in this Office Action; The computer system further includes a remote translation lookaside buffer (RTLB) that stores a plurality of remote page table entries. Each remote page table entry represents a mapping between a range of physical addresses and a corresponding range of remote physical addresses (abstract); figure 7, 168 shows an ERTT header (the RPPA entry) comprising Node-ID, size, control flag and remote physical page address; figure 6 further shows that a plurality of the RPPA entries being organized into a RTLB (Remote Translation Lookaside Table) and being accesses using the index V; figure 5 illustrates how the mapping from a virtual node to a physical node is accomplished; thus it is clear that an ERTT header can be located and obtained from the RTLB as shown in figure 6].

As to claim 5, Vishin et al. teaches that **the ERTT header is located on a predetermined virtual node** [refer to "Response to Remarks and Amendments" presented earlier in this Office Action; The computer system further includes a remote translation lookaside buffer (RTLB) that stores a plurality of remote page table entries. Each remote page table entry represents a mapping between a range of physical

Art Unit: 2186

addresses and a corresponding range of remote physical addresses (abstract); figure 7, 168 shows an ERTT header (the RPPA entry) comprising Node-ID, size, control flag and remote physical page address; figure 6 further shows that a plurality of the RPPA entries being organized into a RTLB (Remote Translation Lookaside Table) and being accesses using the index V; figure 5 illustrates how the mapping from a virtual node to a physical node is accomplished; thus it is clear that an ERTT header can be located and obtained from the RTLB as shown in figure 6].

As to claim 6, refer to "As to claim 1" presented earlier in this Office Action. Further, Vishin et al. teaches that **an operating system executable by a source node of the plurality of nodes** [refer to "Response to Remarks and Amendments" presented earlier in this Office Action; The 32 entries in the RTLB are organized into four groups of eight entries (entries 0:7, 8:15, 16:23 and 24:31). While the physical address ranges of the RPTes in any one group may overlap, it is the responsibility of the operating system 180 (see FIG. 9) to make sure that the RPTes in different groups do not have overlapping address ranges (column 5, lines 33-37)].

As to claim 9, refer to "As to claim 4" presented earlier in this Office Action.

As to claim 10, refer to "As to claim 5" presented earlier in this Office Action.

As to claim 11, refer to "As to claim 1" presented earlier in this Office Action.

As to claim 14, refer to "As to claim 4" presented earlier in this Office Action.

As to claim 15, refer to "As to claim 5" presented earlier in this Office Action.

As to claim 16, Vishin et al. teaches **replicating the ERTT header on a plurality of nodes** [refer to "Response to Remarks and Amendments" presented earlier in this

Art Unit: 2186

Office Action; figure 1 shows a multi-node system where each cluster (102) represents a node connected together by a network (114), and each cluster (102) has a copy of RTL (160) of its own].

As to claim 17, refer to "As to claim 16" presented earlier in this Office Action.

As to claim 18, refer to "As to claim 16" presented earlier in this Office Action.

6. *Related Prior Art*

The following list of prior art is considered to be pertinent to applicant's invention, but not relied upon for claim analysis conducted above.

- Vishin et al. et al. (US 6,925,547), "Remote Address Translation in a Multiprocessor System."
- Scott, (US patent Application Publication 2004/0044872), "Remote Translation Mechanism for a Multi-Node System."
- Deneau, (US 6,684,305), "Multiprocessor System Implementing Virtual Memory Using a Shared Memory, and a Page Replacement Method for Maintaining Paged memory Coherence."
- Frank et al., (US 6,490,671), "System for Efficiently Maintaining Translation Lookaside Buffer Consistency in a Multi-Threaded, Multi-Processor Virtual Memory System."
- Hansen, (US 6,101,590), "Virtual Memory System with Local and Global Virtual Address Translation."

Conclusion

- 7.** Claims 1, 4-6, 9-11 and 14-18 are rejected as explained above.

8. THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sheng-Jen Tsai whose telephone number is 571-272-4244. The examiner can normally be reached on 8:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Kim can be reached on 571-272-4182. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.


Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Application/Control Number: 10/643,588
Art Unit: 2186

Page 11

Sheng-Jen Tsai
Examiner
Art Unit 2186

April 11, 2007


PIERRE BATAILLE
PRIMARY EXAMINER
4/12/07